Space Weather Technical Forecast

Issued on Thursday 6 February 2025 at 00:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of glancing blows from two CMEs. Higher confidence for coronal hole arrival day 4. Further M-class flares expected, slight chance of an X-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was moderate over the past 24 hours with two M-class flares. These originated from AR3981 and AR3977, with the peak an M2.7 flare at 05/0750 UTC from AR3977.

There are currently up to nine active regions on the Earth-facing disc. The majority of the activity is from the broad cluster of sunspots now transiting across the northwest quadrant, and consisting of AR3976, AR3977, AR3978, AR3981and AR3984. These form a rather large and complex area of multiple bipolar active regions, with signs of magnetic interaction between the regions. Most of these regions have shown slight recent decay, although some new minor spots emerged within AR3978. AR3981 to the rear of this cluster is by far the largest individual region and most active. It has two delta configurations within its intermediate and trailer spots, with north-south shear evident, although these spots are showing a slight decaying and splitting trend. The remaining spots are all small and simple.

No Earth directed CMEs (coronal mass ejections) were observed in available imagery in the past 24 hours. However, there is a low chance of a glancing blow from a southwest filament eruption from early 05 Feb.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE at L1, ranged between 380-450 km/s. Density was below average or average. The Interplanetary Magnetic Field, Bt, was mostly weak, 8nT or lower. The north-south component, Bz, varied weakly. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels. High energy electron flux (greater than 2MeV) at GOES16 was at background to moderate levels, peaking at 427 pfu. The associated 24-hour fluence persisted below the Active threshold, recording 1.15e7 integrated pfu at 06/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Moderate activity is forecast, with M-class flares expected at times and a slight chance of rising to High, with isolated X-class flares, primarily from the regions in the north

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spanning centre disc into the western hemisphere.

Solar Wind / Geomagnetic Activity: Two CMEs feature in the forecast, one from 02 Feb which may give a glancing blow with Earth on the morning of day 1 (06 Feb). Another from a filament eruption in the southwest from early on 05 Feb, which has a low chance for a glancing blow late day 2 or day 3 (07/08 Feb). Both are low confidence. The potential for further CMEs and hidden transients is currently elevated.

Solar wind speeds are expected to be background to slightly elevated for much of the period, although could perhaps return to slightly elevated to elevated levels should either of the two CMEs arrive. The next recurrent feature will be the high speed stream of CH13/-. This is expected to most likely arrive at Earth on 09 Feb, although there is a chance it may become geoeffective later day 3 (08 Feb).

Generally Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected for much of the period. However, there is a chance following any potential CME arrival early day 1, and perhaps a slight chance late day 2 into day 3, of seeing activity temporarily increase to G1-G2/Minor-Moderate Geomagnetic Storm intervals (Kp 5-6). Also, later day 3 there is a slight chance for G1/Minor Storm conditions to develop should the next high speed stream arrive, although this is more likely into day 4 (09 Feb).

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to be at background levels, but with a slightly increased potential of responding to any notable flares as the sunspot regions in the north move further across the western hemisphere. High energy electron flux observed at GOES16 has remained at Moderate levels. This is expected to persist, with just a slight chance of becoming briefly diurnally High. The corresponding 24 hour fluence is expected to persist below the Active threshold.

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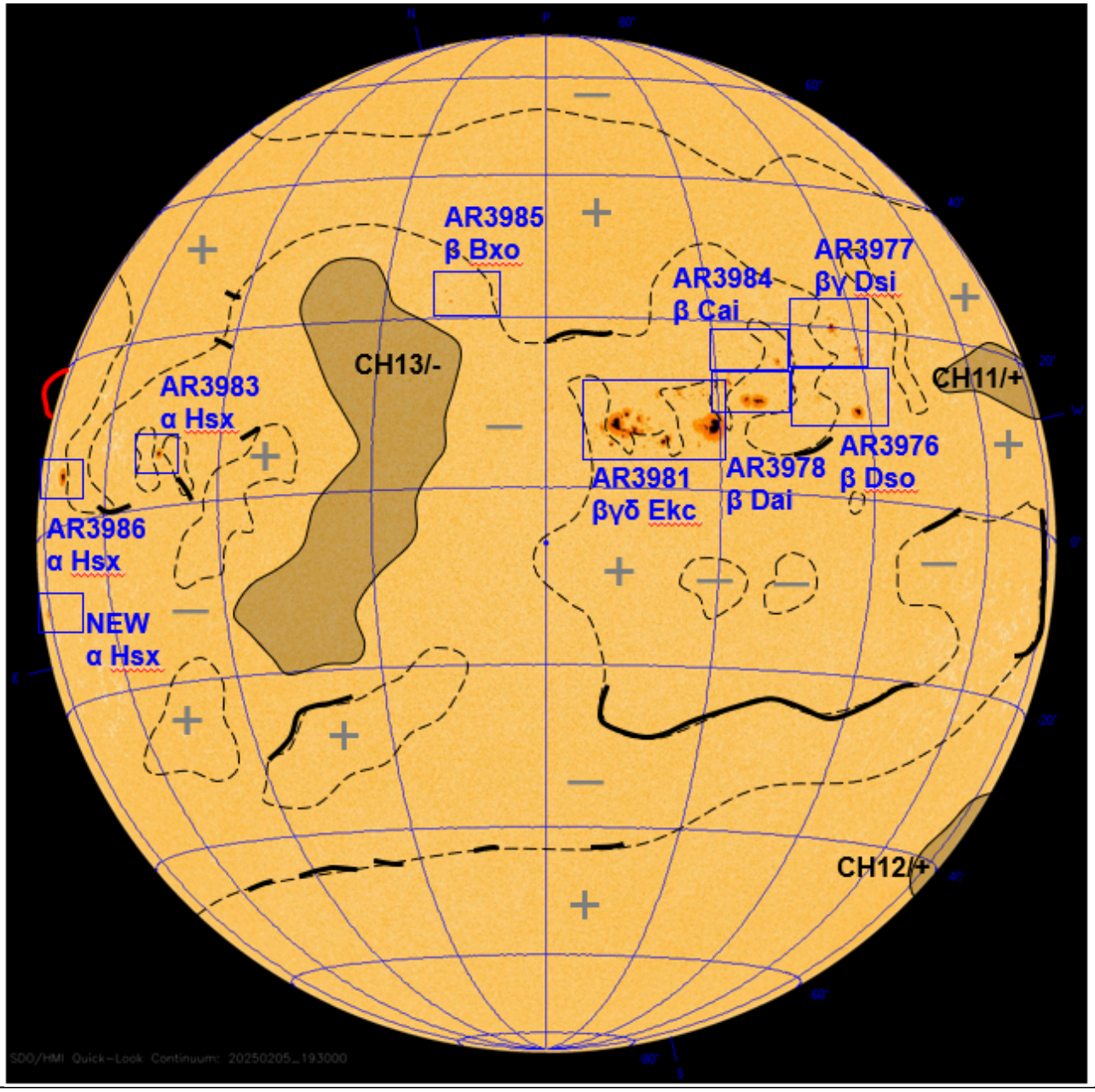
Figure 1: Solar Synoptic Map valid 05/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Two CMEs currently feature in the forecast, the first is a faint CME associated with an M4.1 flare at 02/2320 UTC from AR3981. This CME occurred at a similar time as a larger, far-sided CME, which lowers the confidence of analysis. However there is a possibility the CME could make a glancing impact with Earth on the morning of day 1 (06 Feb). The second CME is from a large filament eruption in the southwest early on 5th Feb. This CME has been analysed as a probable miss, but there remains a low chance for some glancing influence at Earth any time from late on day 2 (07 Feb) until end of day 3 (08 Feb). Given the apparent amount of material which erupted from this filament, should it arrive at Earth it could give a noticeable impact. The potential for further CMEs and hidden transients also remains elevated, with a number of large filaments in potentially geoeffective positions and the large cluster of the sunspots to the north still producing M-flares.

Solar wind speeds have varied between background and slightly elevated levels, 380-450km/s. Similar solar wind speeds are expected for much of the period, although could perhaps return to slightly elevated to elevated levels should either of the two CMEs arrive. The next recurrent feature will be the high speed stream of CH13/-. This is expected to most likely arrive at Earth on 09 Feb, although there is a chance it may become geoeffective later day 3 (08 Feb). MOSWOC ENLILs solar wind speeds are considered generally well modelled, but perhaps a little early with the onset of the next high speed stream.

Generally Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected for much of the period. However, there is a chance following any potential CME arrival early day 1, and perhaps a slight chance late day 2 into day 3, of seeing activity temporarily increase to G1-G2/Minor-Moderate Geomagnetic Storm intervals (Kp 5-6). Also, later day 3 there is a slight chance for G1/Minor Storm conditions to develop should the next high speed stream arrive, although this is more likely into day 4 (09 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	30	10	20	40
Strong	**G3**	No	5	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
03/0457	Partial	AR3981	NE	590	06/0700 +/- 6 hours	Chance of glancing impact, but low confidence.
05/07:00	Partial	Filament	SW	790	08/0000 +/- 6 hours	Low chance of glancing impact.

Figure 2: MOSWOC ENLIL

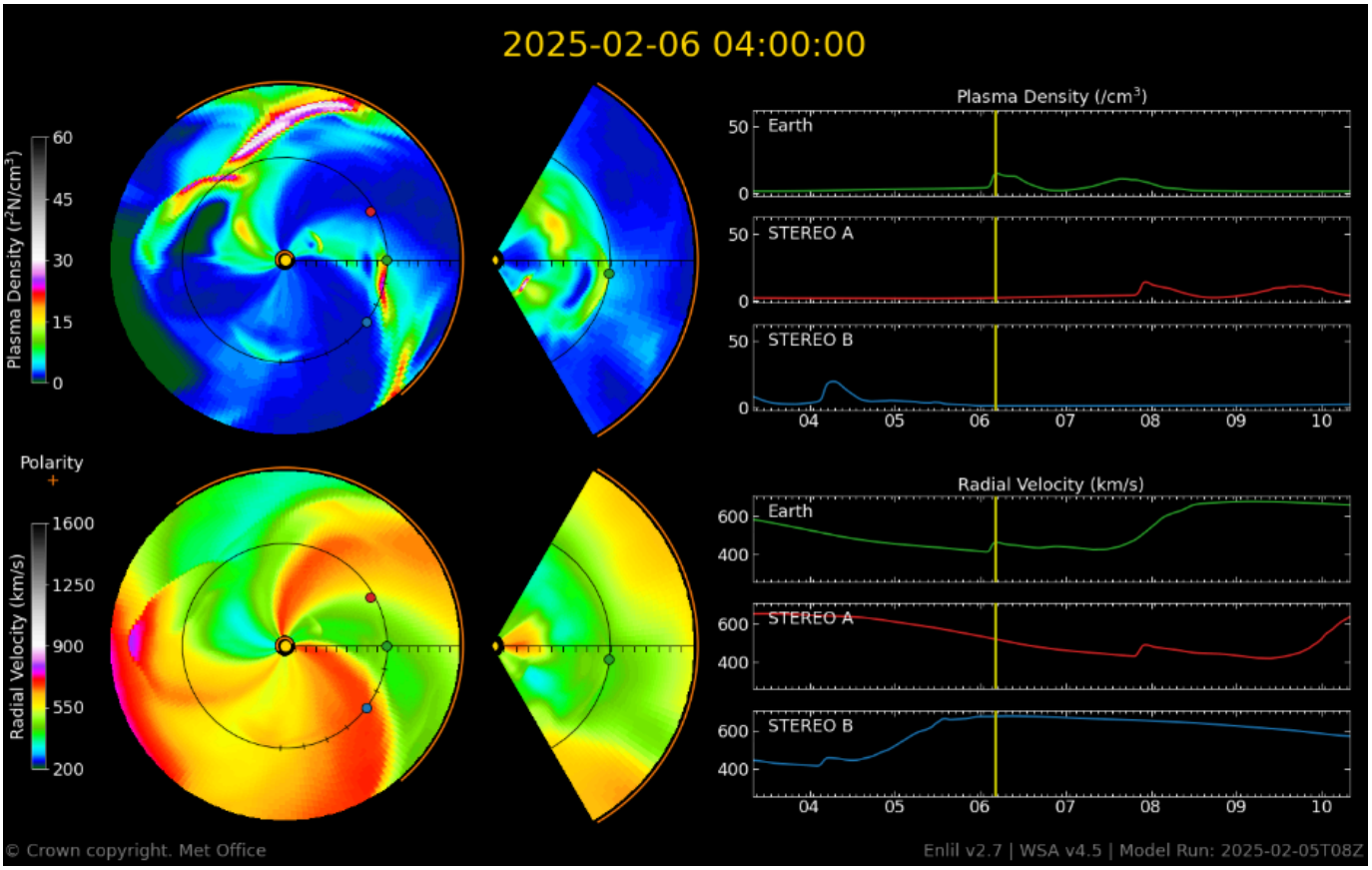

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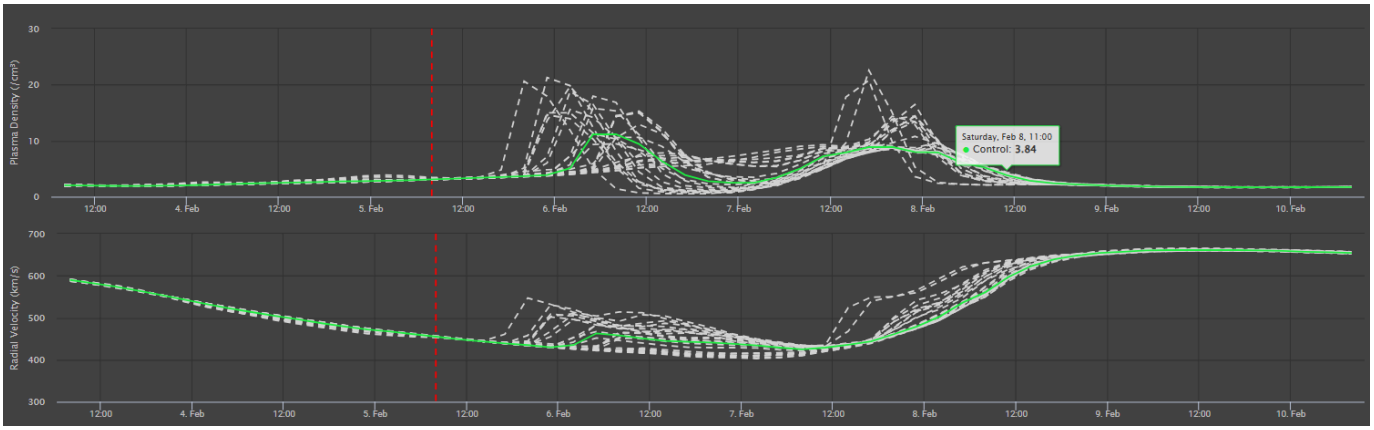
Figure 3: MOSWOC ENLIL ensemble.



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Radio Blackouts - X-Ray Flares

Solar activity was moderate over the past 24 hours with two M-class flares. These originated from AR3981 and AR3977, with the peak an M2.7 flare at 05/0750 UTC from AR3977.

There are now up to nine active regions on the Earth-facing disc. The majority of the activity is from the broad cluster of sunspots now transiting across the northwest quadrant, and consisting of AR3976, AR3977, AR3978, AR3981and AR3984. These form a rather large and complex area of multiple bipolar active regions, with signs of magnetic interaction between the regions. Most of these regions have shown slight recent decay, although some new minor spots emerged within AR3978. AR3981 to the rear of this cluster is by far the largest individual region and most active. It has two delta configurations within its intermediate and trailer spots, with north-south shear evident, although these spots are showing a slight decaying and splitting trend. The remaining spots are all small and simple.

Further M-class flares are anticipated, primarily from AR3981, with a slight chance of an X-class flare.

Recurrence suggests the potential for one returning region during the period, however far-side helioseismic output has no strong signals for a particularly significant active region.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	80	80
Very Active	R3-R5 (X Class)	No	20	20	20	20

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Solar Radiation Storms (High Energy Protons)

Proton flux as observed by GOES-18 is currently at background levels, and is likely to remain that way. However, as the large cluster of sunspots in the north continue to transit across the western hemisphere, there is an increased chance of proton flux rising in response to any notable flares.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	25	25	25
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has remained at Moderate levels and on a flat trend. The next likely charging mechanism for the Van Allen belts is CH13/-, but any subsequent significant rise in electron levels is expected to be beyond the current forecast period.

The corresponding 24 hour fluence is expected to persist below the Active threshold. MOSWOC REFM output is currently thought to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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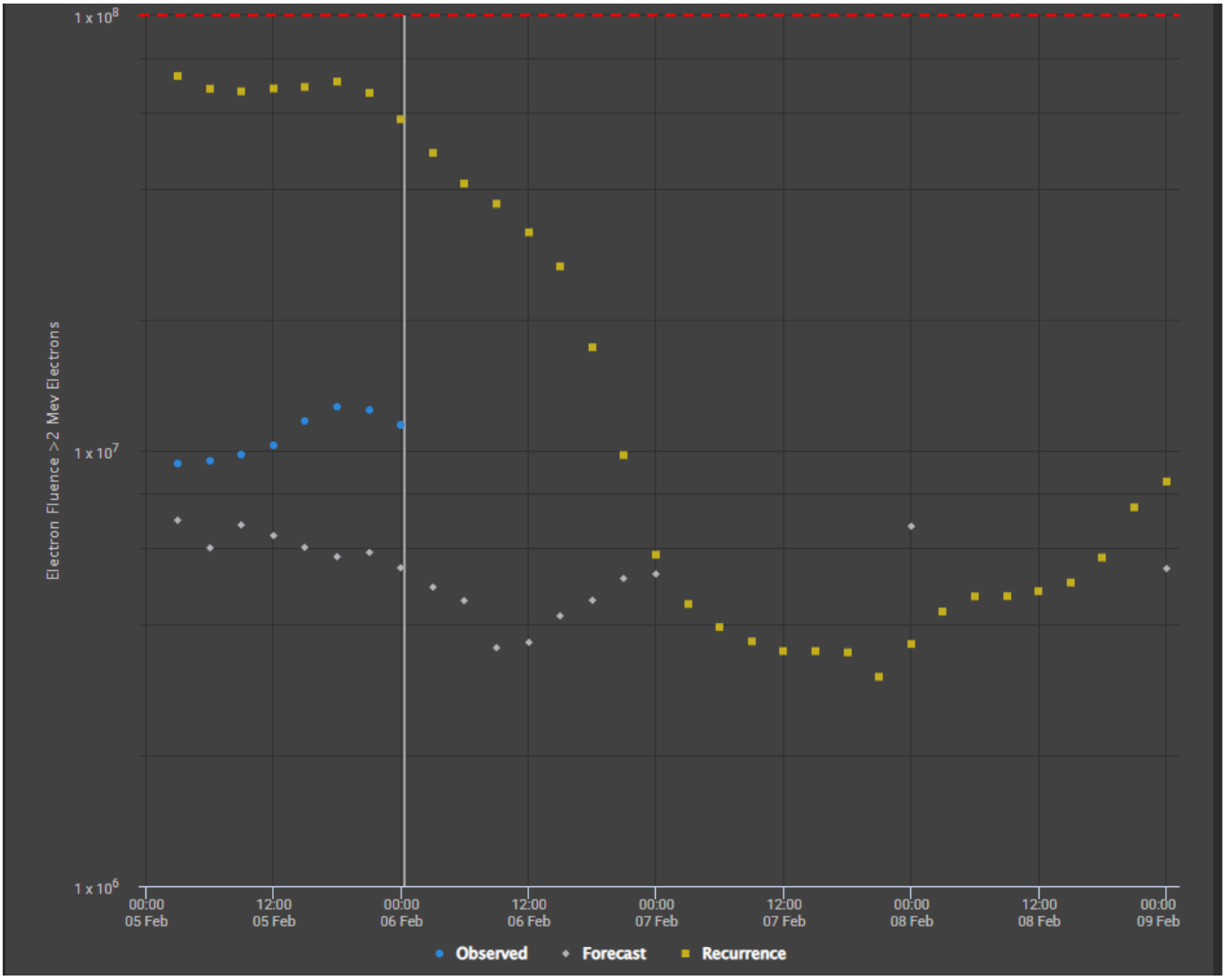
Figure 4: MOSWOC REFM



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